National Aeronautics and Space Administration

# GoddardView

Volume 12 Issue 10
October 2016

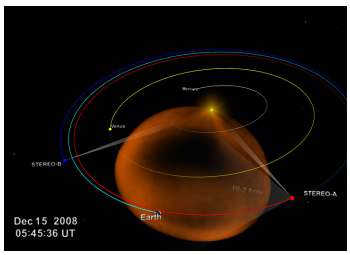

www.nasa.gov

# GoddardView

## TRENDING

**NASA Social Brings Out Social Media Followers to Antares Launch**
In celebration of the first Antares rocket launch from Wallops Flight Facility since 2014, the facility hosted some of NASA's biggest social media followers for a series of talks and tours, as well as a viewing of the launch.

**Hubble Finds Significantly More Galaxies in Universe**
A census assembled from surveys taken by the Hubble Space Telescope and other observatories has revealed that the observable universe contains 10 times more galaxies than astronomers previously thought.




**A Decade of STEREO**
Launched on Oct. 25, 2006, the twin spacecraft of the STEREO mission have provided stereoscopic images of the sun and other phenomena for more than a decade, providing scientists information on how events such as coronal mass ejections impact Earth.

**Webb Sunshield Now Complete**
The last of the five sunshield layers for the James Webb Space Telescope has been successfully installed at Northrop Grumman's facility in Redondo Beach, Calif. The sunshield will prevent sun-heat from interfering with Webb's sensors.

**GoddardView**



**On the cover**: The Orbital ATK Antares rocket several days prior to its launch from Wallops Flight Facility in Virginia.

Photo credit: NASA/Bill Ingalls

NP-2016-10-523-GSFC

## GoddardView Info

Goddard View is an official publication of NASA's Goddard Space Flight Center in Greenbelt, Maryland. Goddard View showcases people and achievements in the Goddard community that support the center's mission to explore, discover and understand our dynamic universe. Goddard View is published by the Goddard Office of Communications.

You may submit story ideas to the editor at darrell.d.delarosa@nasa.gov. All contributions are subject to editing and will be published as space allows.

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# GODDARD HOSTS AGENCYWIDE SPACE WEATHER AND EXPLORATION WORKSHOP

By Lina Tran

From Sept. 27-28, scientists and operators from NASA centers across the country flocked to NASA's Goddard Space Flight Center for the eighth annual Space Exploration and Space Weather Workshop. The workshop was jointly hosted this year by Goddard's Community Coordinated Modeling Center and Space Weather Research Center (CCMC/SWRC) and the Space Radiation Analysis group, or SRAG, from NASA's Johnson Space Center in Houston. Yari Collado-Vega and Antti Pulkkinen, two Goddard space weather scientists, organized the two-day event.

"Every year, the workshop tries to emphasize an area of importance for improving our space weather analysis to the NASA robotic missions," Collado-Vega said.

In the early days of space exploration, scientists were only just beginning to understand how the sun's activity creates and affects space weather, and how radiation from space weather can impact humans and technology. After decades of space radiation research, it's clear that understanding the connections between space weather and space exploration is quite necessary. Space radiation is a constant concern and must be considered at every level and stage of exploration. Unchecked radiation can interrupt electronics and disturb communications signals. For humans, radiation increases the risk of cancer and can cause acute radiation sickness if exposed to very large doses.

During the workshop, scientists provided status updates for heliophysics missions and demonstrated use of CCMC/SWRC tools which monitor and forecast space weather daily for NASA's robotic missions.

"What was special this year was that instead of focusing on robotic missions only, we focused on the robotic and human exploration side of things as well," Pulkkinen said.

Normally, Earth's protective magnetosphere shields us from the sun's harmful radiation. But as we continue to venture farther past the reach of Earth's magnetic field, scientists must take measures to protect both robotic and human explorers. This often takes the form of radiation-shielding with specialized materials composed of atoms small enough to deflect energetic particles.

"In some cases for robotic missions, folks may just turn instruments off, but you can't turn off a human," Pulkkinen said. To ensure crew safety on future deep-space missions, scientists and engineers are investigating ways to construct storm shelters or rearrange parts within a spacecraft to reduce exposure to particularly strong bouts of radiation.

The workshop culminated in two case studies developed by SRAG, placing into motion an idea that began at last year's workshop. In the first case study, workshop scientists imagined the first human mission into deep space with NASA's Space Launch System, and in the second, they pictured an intense radiation storm on Mars, endangering a human crew on the surface. Gathering in small groups, the space weather scientists brainstormed their way through each scenario: What instrumentation, data and models would they need to support the missions and safeguard the astronauts?

"The case studies help the audience interact with each other and pave the way for more collaborations between missions and research teams," Collado-Vega said. ■

Above: Attendees gather for discussions during the eighth annual Space Exploration and Space Weather Workshop at NASA's Goddard Space Flight Center.

Photo courtesy: NASA/Goddard/Yari Collado-Vega


Impact history of the Moon
Lunar geologic processes
and their role in the evolution of the lunar crust
Formation of the lunar regolith
Volatiles on the Moon, especially at the poles
Lunar radiation environment

# SPACE EXPLORERS GATHER AT GODDARD FOR INTERNATIONAL OBSERVE THE MOON NIGHT

By Celina Hanewich

Every year, thousands of space enthusiasts around the world take part in International Observe the Moon Night (InOMN), a celebration of lunar and planetary science and exploration taking place in the fall, when the moon is around its first quarter. Sponsored by NASA's Lunar Reconnaissance Orbiter (LRO) mission and several astronomical organizations, InOMN holds activities at a variety of venues, from museums and schools to business offices and backyards.

On Oct. 8, NASA's Goddard Space Flight Center held its seventh annual celebration of the event. More than 370 attendees made their way to the Goddard Visitor Center for an evening of presentations, family-friendly activities and lunar viewing.

In one of the more popular talks, Erwan Mazarico, Goddard research scientist, presented LRO data on the moon and showcased some of the mission's most fascinating photos.

Participants could also view digital presentations on the visitor center's Science On a Sphere (SOS) exhibit – a display system that uses computer and video to project moving images on a 6-foot-diameter sphere. Organizers took the opportunity to premiere a new SOS video on Titan, Saturn's largest moon, with explanations provided by planetary scientist Conor Nixon.

In another semi-debut, visitors had the chance to view the new NASA music video "The Moon and More" and got a behind-the-scenes look at its making from Goddard video producer David Ladd. Inspired by the LRO mission, "The Moon and More" features songwriter Matt Cusson and Javier Colon, who won the first season of NBC's "The Voice" singing competition.

Children could also create "moon cookies" and read books about the moon. The Goddard Office of Communications provided a digital photo booth that gave visitors a chance to get their picture taken on a postcard-sized image of space.

Telescopes were set up in the visitor center's rocket garden to view the moon and other celestial objects.

Goddard heliophysicists set up a table to discuss the total solar eclipse that will pass by the United States on Aug. 21, 2017. It will be the first eclipse to be visible from the contiguous part of the country since 1979.

For more information on International Observe the Moon Night, visit www.observethemoonnight.org. ■

Center: Attendees view a presentation about Titan, Saturn's largest moon, on the visitor center's Science On a Sphere exhibit. Photo credit: NASA/Goddard/Bill Hrybyk


Opposite: Goddard's Erwan Mazarico explains the purpose of the Lunar Reconnaissance Orbiter mission (top). A young visitor views objects in space through one of the telescopes provided throughout the evening (bottom). Photo credits: NASA/Goddard/Bill Hrybyk

Bottom: Children participate in hands-on moon-related activities. Photo credit: NASA/Goddard/Bill Hrybyk

# TO(MS) RUSSIA WITH LOVE: TEAM REFLECTS ON PIONEERING MISSION 25 YEARS LATER

By Darrell Dela Rosa

In November, a three-person crew from NASA, Roscosmos and the European Space Agency will launch aboard a Soyuz rocket from the Baikonur Cosmodrome in Kazakhstan en route to the International Space Station (ISS), continuing 16 years of uninterrupted work aboard the orbiting laboratory. First assembled in 1998 and staffed with its first crew in 2000, the space station was founded as a platform for scientific research, serving as a springboard for future collaboration in space exploration among space agencies worldwide.

The seemingly routine cooperation inherent in ISS expeditions, now totaling 50 since Expedition 1, is far removed from the largely adversarial approaches that characterized the space programs of Cold War rivals – the United States and Soviet Union – during the Space Race. Today's institutional nature of friendly space relations between the United States and Russia, formerly the central republic of the Soviet Union, is partially rooted in a few joint missions that surfaced during those decades of political and cultural tension.

In July 1975, as a symbolic gesture of détente that both sides pursued at the time, NASA astronauts and Soviet cosmonauts orbited Earth in tandem as an Apollo Command and Service Module docked with a Soyuz spacecraft.

And in 1991, just months prior to the dissolution of the Soviet Union that December, a team of about 60 scientists and engineers from NASA's Goddard Space Flight Center made their way to the Eastern Bloc and worked with more than 40 of their Soviet counterparts to launch a Total Ozone Mapping Spectrometer (TOMS) aboard a Soviet Meteor-3 spacecraft. The mission, first conceived in the late 1980s, was a byproduct of the Reagan administration's attempt at normalizing bilateral relations with the Soviet Union as well as the evolving uses of the TOMS instrument.

*The Soviet Meteor-3 rocket launches the TOMS instrument into space from Plesetsk on Aug. 15, 1991.*

*Photo courtesy: NASA/Goddard/Charles Cote*

First launched aboard a Nimbus-7 spacecraft in 1978, TOMS was originally designed to study weather patterns by mapping global ozone. Environmental concerns over long-term damage to the ozone layer by chlorofluorocarbons began to gain ground in subsequent years, especially after the detection by TOMS of a deep hole in the ozone over the Antarctic.

"TOMS shifted from simply making meteorological measurements to helping address broader environmental matters, and the Soviet Union joined the Montreal Protocol – an international treaty designed to protect the ozone layer and monitor the state of global ozone," said Arlin Krueger, Goddard's project scientist for the follow-on mission who advocated for its inception. "Combine these factors with the Reagan administration's diplomatic agenda, and the mission came to be."

Krueger, Project Director Charles Cote and several team members – along with officials from NASA Headquarters and the U.S. State Department – made their first reconnaissance visit to Moscow in 1988. Three years of planning and integration followed at Goddard and in Istra, a town 25 miles northwest of the capital with facilities that served as Goddard's equivalent for the Soviet space program.

In August 1991, in their own Apollo 11-like moment, the team members became the first Americans to set foot in Plesetsk – a former secret Soviet missile base just outside the fringes of the Arctic Circle – to participate in the launch.

There were fewer protocols in place for Soviet launches compared to those for NASA, and scientists and engineers were permitted to view the Meteor-3 rocket up close just minutes prior to blastoff – a sign of the Soviets' relatively casual approach to space exploration that the Goddard team would work to overcome. On Aug. 15, with spectators standing a mere 300 yards away – compared to 2 to 3

miles for NASA launches – TOMS took off within just 400 milliseconds of the scheduled launch time.

"The mission was important in many contexts, but first and foremost is the fact that the two superpowers collaborated in monitoring the ozone layer," added Krueger.

Members of the Goddard team recently gathered at Krueger's home to celebrate the pioneering mission's 25th launch anniversary. Among them was Cote, who credits the willingness of both sides to overcome the pervasive distrust of the Cold War for the successful launch.

"Our achievement, the first joint flight of a NASA instrument on a Soviet spacecraft in which teams from both nations worked side by side in Soviet facilities for planning and integration, was made possible only through the combined efforts of many specialists working toward a common goal and through collaboration on technical, scientific and personal levels in both countries," he said.

From the outset, however, language and cultural differences added more levels of complexity to an already difficult project. Some of the Soviets were also veterans of the race to the moon in the 1960s, while many on the Goddard team were decades younger. Alex Koorbanoff, an interpreter with prior experience in defense and intelligence, was brought on board to facilitate communication between the parties and open channels for negotiation.

"There was an obvious generational divide," he said. "There were noticeable differences in age and work culture, as well as in what was needed to earn the other side's respect."


*Several members of Goddard's Meteor-3/TOMS team in the Soviet Union in 1991. From left to right: Ulli Hartman, Mike Bremmer, Arlin Krueger, Charles Cote, Tom Board, Ben Cano, Eve Wooldridge, Alex Koorbanoff, Gene Volpe, Diane Shuster, Sergei Tregubov, John Loiacono and Curtis Gordon.*

*Photo courtesy: NASA/Goddard/Charles Cote*

And cultural concerns were not the only obstacles to achieving heightened cooperation. "There were difficulties in finalizing the implementation agreement, and from a technical standpoint, our engineers had to wrap their heads around what the other side was talking about," recalled Koorbanoff. "They were using technical terminology different from our own."

Contamination control also lagged behind NASA's standards, with clean rooms and garments absent from many facilities. Eve Wooldridge was tasked with monitoring the contamination of TOMS and the spacecraft, which required the Soviets to provide clean tents and NASA to bring contamination control supplies, including bunny suits and cleaning mops that the Soviets lacked. Koorbanoff helped her overcome the language barrier, but over time she developed with one of her counterparts a special rapport that required less verbal communication.

"Right before the TOMS instrument arrived, their contamination expert Dr. Zavgoradny and I started understanding each other without using many words, and his crew cleaned up everything I asked them to," she said. "They even called on mountain climbers to clean the huge facility in Plesetsk."

John Loiacono was one of the youngest members of the team, serving as the mission's instrument manager whose job was to lead the building of the instrument as well as its integration onto the Meteor-3 spacecraft. Age differences notwithstanding, he found a way to strengthen relationships through his youthful exuberance.

"Given that it was early in my career, I was concerned about doing a good job and less concerned about everything else," he said. "And by concentrating on getting the job done, we formed a good relationship with the Soviets. We certainly had our philosophical differences, but the working relationship that we formed was key to a successful mission."

Loiacono and others from NASA and the Soviet program would go on to create a glossary explaining the differences in terminology between the two sides. Several iterations later, the glossary would eventually find its way aboard the International Space Station – where it is still used to this day – to streamline communication between astronauts from different nations.

On Aug. 19, four days after the launch, a few on the Goddard team remained in Moscow to send activation commands to the instrument when seven hard-line members of the Soviet communist party, expressing discontent with

*(continued on page 8)*

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then-President Mikhail Gorbachev's reforms aimed at restructuring the country's political and economic systems, initiated a coup attempt to overthrow the leader and take over the government. The coup would collapse on Aug. 21, and the Goddard team would make it home safely. The event, however, is widely considered to have contributed to the demise of the Soviet Union four months later, effectively cementing the historical legacy of the Meteor-3/TOMS mission as the first and only one of its kind.

The second-generation TOMS instrument would extend the ozone record begun by its Nimbus-7 predecessor through 1994. A third-generation instrument – dubbed "Earth Probe TOMS" – would launch in July 1996 with the expanded role of monitoring volcanoes, forest fires and sources of pollution in addition to global ozone.

This was followed by a copy of Earth Probe TOMS that launched the following August aboard Japan's Advanced Earth Observing Satellite.

NASA sent Loiacono to California to oversee development of both sets of TOMS instruments upon his return from the Soviet Union, and Krueger continued as the TOMS program's instrument scientist.

Today, Loiacono remains at Goddard and serves as the deputy project manager for the recently launched OSIRIS-REx asteroid sample return mission.

For his part, Koorbanoff – now a corporate consultant based out of Florida – spent the better part of three decades living and working in Russia.

Wooldridge, who was often referred to as the "Mother of Contamination Control in Russia," now brings her cleanliness capabilities to the James Webb Space Telescope – set to become the most powerful space telescope ever built upon its completion and launch in 2018. She revisited Moscow in 1995, but it was never the same.

A bustling metropolis emerged from the ruins of the Cold War, with luxury developments and high-end retailers eventually supplanting the decrepit infrastructure and bread lines that typified the city during much of the 20th century.

"It's amazing to see how young we were and the state of the Soviet Union at the time," said Wooldridge while watching footage of the mission at Krueger's gathering. "Looking back, I'm glad I got to participate in this mission when I did. I got to see the country in a way that nobody again ever will."

*Members of the team recently gathered at the home of Arlin Krueger, Meteor-3/TOMS project scientist, to celebrate the mission's 25th launch anniversary. From left to right: Stanley Way, John Loiacono, Alex Koorbanoff, Tom Board, Serge Tregubov, Diane Schuster, Charles Cote, Eve Wooldridge and Arlin Krueger.*

*Photo credit: Delinde Photography/Russell Wooldridge*

NASA and Roscosmos collaborated on many missions in the ensuing quarter century. In 2001, a version of NASA's Stratospheric Aerosol and Gas Experiment instrument would launch aboard a similar Meteor-3 spacecraft. Several Russian instruments have been used in such NASA missions as the Lunar Reconnaissance Orbiter and the Mars Science Laboratory.

Among many other expeditions aboard the International Space Station, NASA astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko jointly participated in an unprecedented one-year mission from March 2015 to March 2016 to study the effects of long-duration spaceflight on humans. The results of the mission will help NASA in planning for an eventual human spaceflight to Mars.

"Since 1991, many successful cooperative projects in space have been accomplished between the United States and Russia, but history always remembers the firsts," said Cote. "We were given the unique opportunity to demonstrate our will to merge our scientific and technical expertise in a joint mission with important values to science and mankind. We did it through teamwork and cooperation, having established mutual trust and respect." ■

# THE BEST IN COLLABORATION, INFUSION AND PERSISTENCE

By Lori Keesey

Two teams whose accomplishments read like a "who's who" in NASA technology development have been selected to receive the FY16 IRAD Innovators of the Year award.

Bestowed annually on those who demonstrate the best in technology development, this year's recognition goes to the Navigator GPS and SpaceCube 2.0 teams thanks to their success merging their technologies to create a more powerful navigational capability: NavCube.

Currently planned for a demonstration aboard the International Space Station in 2018, NavCube is applicable to a broader range of missions, including the possible demonstration of X-ray communications in space — a potential NASA first, according to Goddard Chief Technologist Peter Hughes, who manages the center's Internal Research and Development (IRAD) program.

The office has also awarded technologist George Suarez and fellow team members – Jeffrey Dumonthier and Gerry Quilligan – an honorable mention for their persistence in developing one-of-a-kind circuits designed to enable high-profile missions and increase the reliability of CubeSat missions.

"We're pleased to recognize the achievements of all who are being honored this year," Hughes said. "We invest in R&D to create capabilities that NASA needs. NavCube, in particular, represents infusion at its best. The cross-pollination of the two technologies gives NASA another tool for carrying out a range of science missions. The possibility that it might help demonstrate X-ray communications in space is particularly exciting."

All recipients will be officially recognized during the FY16 IRAD Poster Session in December.

**NavCube Parentage Highly Acclaimed**

The two technologies that parented NavCube are highly acclaimed themselves.

Since its initial development more than a decade ago, SpaceCube has evolved into a family of computing platforms. This year's award recognizes the SpaceCube 2.0 team, led by Dave Petrick, who won the Moe Schneebaum Memorial Award for Engineering earlier this year.

Petrick specifically received the engineering award for his work implementing the processor on a number of future high-profile NASA missions related to robotic servicing and operations in space, including the Robotic Refueling Mission, Raven, Restore-L and the Asteroid Redirect Mission. SpaceCube 2.0 is also providing the central avionics in a possible mission to detect and characterize near-Earth objects. Thanks to the technology's success, Petrick and his team are now working to commercialize SpaceCube 2.0.

The first-generation Navigator GPS receiver, which an Arizona-based aerospace company has already licensed, specifically was designed to meet the challenge of high-altitude GPS navigation and is considered an enabling technology for NASA's Magnetospheric Multiscale mission (MMS). Without Navigator, the mission couldn't fly in the exact formation needed to gather data about magnetic reconnection – the fundamental process that MMS was specifically designed to study.

First demonstrated on the Hubble Space Telescope's Servicing Mission 4, the Navigator technology is now providing operational navigation for NASA's Global Precipitation Mission and has been incorporated in the Orion capsule receiver. In addition, it was used in a GPS Antenna Characterization Experiment — a successful effort that led to the team winning a NASA award in 2015.

Now with the merger, the resulting NavCube has ample processing capability for tackling the next set of navigational challenges, including tracking modernized GPS and Global Navigation Satellite Systems' signals. The improved sensitivity will support higher-altitude missions. In addition, the potential integration of a transponder capability could support next-generation space networks. ■

Center: The winners of the FY16 IRAD Innovators of the Year award include (front, from left to right): Monther Hasouneh, Dave Petrick, Milt Davis; (middle, from left to right) Jennifer Donaldson, Yan-Lu "Annie" Chen, Robin Ripley, Tony Marzullo, Luke Winternitz; (back, from left to right) Mike Jackson, Eric Bentley, Harry Stello, Todd Bentley and Luke Thomas. Those not pictured include Matt Owens, Peter Sparacino, Brian Tokarcik and Sabrena Heyward Ball.

Photo credit: NASA/Goddard/Bill Hrybyk

# SPACE STATION CREW GETS SPECIAL DELIVERY FROM VIRGINIA

By Keith Koehler

In late October, astronauts unloaded more than 5,000 pounds of cargo and crew supplies from a Cygnus spacecraft to support dozens of science and research investigations. This shipment of special significance arrived via an Antares rocket from the Mid-Atlantic Regional Spaceport at Wallops Flight Facility in Virginia.

Rocket launches to the International Space Station from Virginia are back. Teams from Orbital ATK, Virginia Space and NASA have worked diligently to achieve the launch following an Antares launch failure in October 2014. Since then, repairs and upgrades to the launch pad have been completed, and the Antares rocket has been upgraded.

“I’m extremely proud of the combined NASA, Orbital ATK and Virginia Space team for their tenacity in restoring a medium-lift launch capability at Wallops,” said Bill Wrobel, Wallops director. “Antares returned to flight brilliantly, and we are looking forward to many more flights in the months and years to come.”

Wallops is responsible for public safety, tracking, telemetry, communications and institutional support, and the facility’s staff spent countless hours to make sure that the range was ready to support the launch.

“Watching the Antares rocket launch Cygnus into orbit from our home port at Wallops Island was a culmination of nearly two years of hard work by our employees, suppliers and our NASA partners,” said Frank Culbertson, president of the Orbital ATK Space Systems Group. “Congratulations to everyone who contributed to the job well done.”

The Antares launch from Wallops was also a boost to the local economy with the influx of those wishing to see the launch; national and international media reporting on the mission; and Orbital ATK, NASA and Virginia Space members coming to the shore to support the flight.

“We are delighted to see the Antares program return to flight,” said Evelyn Shotwell, executive director of the chamber of commerce in nearby Chincoteague. “Increased calls to the chamber office in the last couple of weeks in anticipation of the Oct. 17 launch verify that folks were excited to watch the next resupply mission leave from Wallops Flight Facility.”

The launch is not a one-time event, and preparations are already underway for the next Antares launch in the first quarter of 2017. ■

Above: A Cygnus spacecraft launches aboard an Orbital ATK Antares rocket on Oct. 17 from Wallops Flight Facility to deliver more than 5,000 pounds of supplies to the International Space Station. Photo credit: NASA/Bill Ingalls

Below: NASA Administrator Charlie Bolden (bottom right) congratulates teams at the Wallops control center following the successful launch of the Antares rocket. Photo credit: NASA/Bill Ingalls

Chase Lucas

Code 210I, Contract Specialist

Why Goddard?: I have always been fascinated by space exploration.

Hobbies/interests: Washington Redskins football, soccer, dual stunt kites

Shari A. Miller

Code 250, Environmental Engineer

Why Goddard?: To directly enable missions and institutional support.

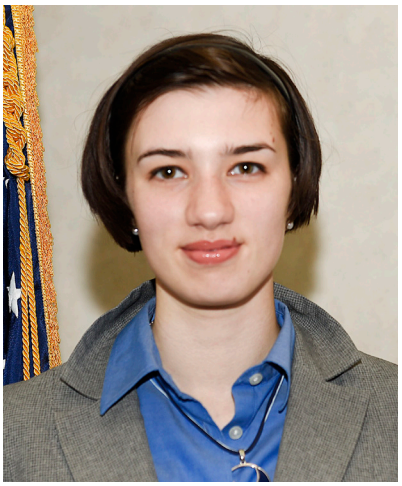
Hobbies/interests: family, dogs, aerobics, traveling

Steve Thornton

Code 730, Associate Chief, ITCD Solutions Division

Why Goddard?: I have been passionate about science and technology from a young age.

Hobbies/interests: running, weightlifting, movies, writing, friends, traveling, volunteering



Monica Gorman Cawley

Code 405, Operations Research Analyst

Why Goddard?: Continuous learning opportunities and the chance to contribute to scientific exploration.

Hobbies/interests: creative writing, running, history

Cody Lanier

Code 405, Operations Research Analyst

Why Goddard?: I wanted to explore my curiosity.

Hobbies/interests: working out, online gaming

Samuel S. Henry III

Code 130, Pathways Intern

Why Goddard?: To contribute to society through a technical path.

Hobbies/interests: family, traveling, roller coasters, music, technology

# EMPLOYEE SPOTLIGHT

*Goddard is pleased to welcome these new employees to the NASA community.*

# JIM GARVIN:
# CATALYZING THE ENGINEERING OF SCIENCE

By Elizabeth M. Jarrell

**What do you do and what is most interesting about your role here at Goddard? How do you help support Goddard's mission?**

I am the professional catalyst who helps inspire the women and men of science and engineering at Goddard to pursue our next missions of discovery. I help catalyze the innovative science for the new missions that our scientists and engineers need to develop for our agency to move forward in our understanding of the universe. I look at myself as someone who channels the ideas of our people to help them implement their ideas now and especially in the future.

I'm also fortunate to have some time to continue as a practicing planetary geoscientist. I'm co-investigator on the Curiosity Mars Rover imaging team. I'm involved with the OSIRIS-REx mission as a supporting investigator for one of its lidar sensors. And I am most privileged to be the deputy principal investigator for the potential Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging (DAVINCI), a mission to bring the United States back to the planet Venus.

**How does a professional catalyst work?**

There are many different ways to catalyze and inspire people to realize their scientific engineering goals and objectives. My particular angle is to be an effective communicator and connector from our people's ideas, such as the question about how Venus' atmosphere works, to colleagues here and across the country, to develop a mission-level solution to address these science questions. I am an enabler in a positive fashion. I help communicate and connect the pieces so others can do the cool stuff in space and discover how our universe works.

**Who helped you become such a brilliant communicator?**

I was fortunate enough to attend Brown University as an undergraduate. The late Brown professor Tim Mutch was a particularly gifted science communicator. He helped catalyze my interest in communicating the "science message" starting when I was a freshman. He became the science leader for the Viking Lander cameras and later the associate administrator for space science at NASA Headquarters.

One of Tim's best friends was Noel Hinners, then Goddard's center director, who hired me straight out of Brown to work as a scientist on Mars and Venus missions at Goddard. He wanted me to extend what we explore at Goddard to other places such as Mars. Noel gave me so many opportunities as an early-career scientist. Within a year of being at Goddard, I was fortunate to be speaking at NASA Headquarters to senior NASA officials and on national television.

**Who inspires you?**

For the most part, teachers have inspired me throughout my life. Noel Hinners was an optimistic, encouraging enabler as a great leader of science here at Goddard and also at NASA Headquarters and at Lockheed Martin. He never said no; instead, he always asked, "How can I say yes?"

I also admired Sally Ride who was quietly focused on doing great things. She was a brilliant physicist who understood spaceflight and was also the first American woman in space. Ed Weiler, a former Goddard center director and NASA associate administrator for space science, is another inspiring leader in the same category.

**How do you inspire others?**

All scientists stand on the shoulders of those who came before them. I try to enable talented young people to go on to achieve great things in science just as others did for me.

**If you could meet and talk to anybody, living or dead, who would it be and what would you ask them?**

One person I would like to talk to is Leonardo da Vinci. I would like to understand how his brilliant thinking could be extended to today's context. It would be revolutionary. His legacy inspired the name DAVINCI for our current Venus mission concept proposal for NASA's Discovery Program. The other person I feel impassioned to meet is the noteworthy explorer Ferdinand Magellan. He was the first person, in effect, to orbit Earth and was the first great exploration mission planner. ■

Center: Jim Garvin

Photo credit: NASA